

## Nickel Sorption Mechanisms in Competitive Sorbent Systems

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**Introduction:** Recent metal sorption studies have shown that the formation of surface precipitates on clay minerals, particularly with metals such as Cr, Ni, Co and Zn, greatly reduces metal availability (1,2). These precipitates form at ambient soil conditions, below saturation conditions in solution and below monolayer coverage. However it has not been proven that these precipitates form to in natural soils. Organic matter and metal oxides, which are often intimately associated with clay minerals, could compete with the clay mineral surface for metal uptake. Extended X-ray Absorption Fine Structure (EXAFS) spectroscopy was used to study the structure of the Ni sorption complex formed on kaolinite coated with either a natural Humic Acid (NHA) or with an iron oxide (goethite).

**Methods and Materials:** The kinetics of Ni partitioning to kaolinite, kaolinite coated with either goethite (~10 wt%) or NHA (3)(~1 and 5 wt%), and NHA and goethite were determined at pH = 7.5, I = 0.1 M NaNO<sub>3</sub>, an initial metal concentration of 3 mM, and a solid solution ratio of 10 g/l. The sorption complex structure of selected samples was characterized with EXAFS. Spectra were collected in fluorescence mode.

**Results:** Macroscopic sorption experiments show a fast initial Ni uptake followed by a slow continued Ni removal in all mineral systems. EXAFS spectra (Fig 1) indicate the growth of a second shell over time in all systems except HA. The Ni containing precipitates were similar in structure to brucite, with Ni and Al in the octahedral layer. The structural parameters derived from fitting procedures agree well with those obtained from earlier studies where the formation of a Ni containing surface precipitate is the dominant sorption mechanism (1).

**Conclusions:** These findings suggest that the incorporation of Ni and other first row transition elements in stable surface precipitates might be an important way to sequester first row transition toxic metals in the environment such that they are less mobile and perhaps less bioavailable.

### References:

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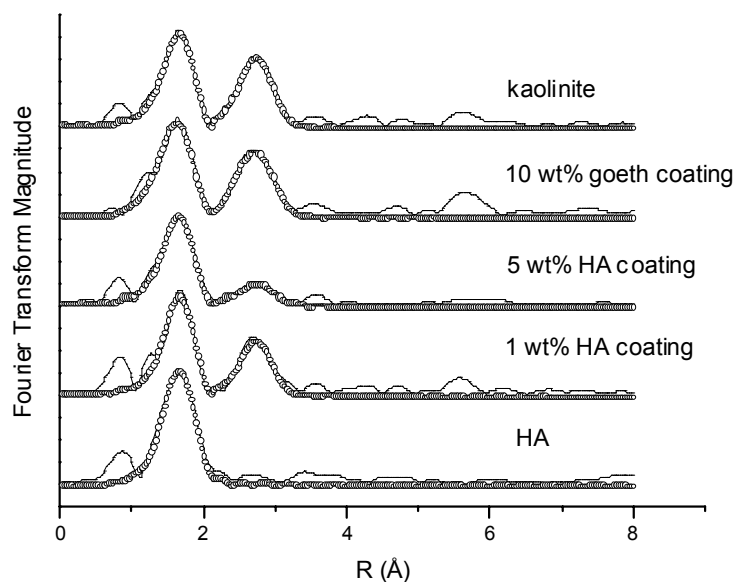


Figure 1: Ni-K $\alpha$  EXAFS spectra of the kaolinite-HA-goethite systems, reacted with a 3mM Ni solution for 4-27 days. The Fourier transformed measured data are indicated with solid lines and fitted radial structure functions are indicated with dotted lines (uncorrected for phase shifts).